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## DEVELOPMENT OF THE FOREST BELTS IN THE NORTH-WESTERN PART OF CLAY COUNTY, KANSAS.

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THE development of forest belts in the northwestern part of Clay county is confined to the bottom lands and bluffs along the Republican river and its tributary creeks. The two main creek systems are Mulberry creek and Five creeks, the sources of both being to the west, in the eastern part of Cloud county. These creeks and their branches lie for the most part in Mulberry, Bloom and Five Creeks townships.

The rocks in the region belong to the Dakota group, except toward the southeast, where the upper part of the Permian limestone begins to outcrop. The soil is thus decidedly sandy, on account of the great abundance of Dakota sandstone, although clays are also abundant. The character of the soil seems to have some influence on the distribution of certain trees and shrubs, for a number of species flourish across the line in the Permian limestone region which are not found in the Dakota.

The Republican river has a wide flood-plain, and in some places the timber belts extend outward a quarter of a mile, though usually much narrower. The woody plants in the river valley in Bloom and Mulberry townships are as follows:

### TREES.

<i>Salix amygdaloides</i> Anders.	<i>Morus rubra</i> L.
<i>Salix missouriensis</i> Bebb.	<i>Cercis canadensis</i> L.
<i>Populus deltoides</i> Marsh.	<i>Gleditschia triacanthos</i> L.
<i>Juglans nigra</i> L.	<i>Gymnocladus dioica</i> (L.) Koch.
<i>Ulmus fulva</i> Mx.	<i>Acer negundo</i> L.
<i>Celtis occidentalis</i> Mx.	<i>Fraxinus lanceolata</i> Borck.

Farther down the river valley *Quercus macrocarpa* Mx. is abundant, but it seems to be practically limited to the Permian outcrops in this region. *Salix nigra* Marsh. may occur also, since it was found in Ottawa county, which joins Clay on the southwest.

### SHRUBS AND SHRUB-LIKE TREES.

<i>Salix cordata</i> Muhl.	<i>Euonymus atropurpureus</i> Jacq.
<i>Salix fluviatilis</i> Nutt.	<i>Rhus glabra</i> L.
<i>Ribes missouriensis</i> Nutt.	<i>Cornus asperifolia</i> Mx.
<i>Rosa arkansana</i> Porter.	<i>Sambucus canadensis</i> L.
<i>Rubus occidentalis</i> L.	<i>Symphoricarpos symphoricarpos</i> (L.)
<i>Prunus americana</i> Marsh.	MacM.
<i>Prunus watsoni</i> Sarg.	<i>Symphoricarpos racemosus</i> Mx.
<i>Amorpha fruticosa</i> L.	<i>Cephalanthus occidentalis</i> L.
<i>Amorpha canescens</i> Pursh.	

In passing up the creek valleys, one meets another shrub, *Prunus virginiana* L. *Rosa arkansana* and *Amorpha canescens* are more properly prairie plants, but invade the forest belt to some extent. All of these shrubs are found in the creek valleys to nearly the upper limit of tree growth, except *Cephalanthus Prunus watsoni*, and *Euonymus*.

LIANAS.

*Smilax hispida* Muhl.  
*Clematis missouriensis* Rydb.  
*Menispermum canadense* L.  
*Rhus radicans* L.

*Celastrus scandens* L.  
*Vitis vulpina* L.  
*Parthenacissus quinquefolia* (L.)  
Planch.

Along Mulberry creek the continuous forest belt ceases about five miles west of its mouth, while the discontinuous belts extend about four miles farther. In passing up the creek valley the five typical trees are box-elder, Green ash, White elm, Honey-locust, and hackberry. Along these are occasional cottonwoods, Peach-leaf willows, or Red mulberries. The Green ash is the first to disappear, usually several miles before the discontinuous forest belt ceases. The remaining four species extend to the limit of tree growth, with an occasional cottonwood or Peach-leaf willow. Half a mile beyond the river belt not an individual, young or old, was seen of the following species: Black walnut, Slippery elm, redbud and coffee-bean. Near the upper limits of the creek the banks are lined with *Amorpha fruticosa* and occasional clumps of Peach-leaf willows. The Poison ivy is the most aggressive of the lianas and extends to the very limits of shrubs and tree growth.

The conditions on Five Creeks are practically the same. North creek, which is a prominent tributary, extends through the southern part of Bloom township. The Green ash is the least progressive up stream of the five typical trees. As one passes near the limits of the continuous forest belt the box-elder is the most abundant, with White elm, Honey-locust, hackberry, Peach-leaf willow, and cottonwood, in about the order named. The shrubs and lianas are similar to those on Mulberry creek. At the upper end of the creek, most of the woody plants are on the steep grassless bluffs, especially on those facing the north. At the mouth of the Five Creeks, which is on the border of the limestone region, the following trees are present:

*Salix amygdaloides* Anders.  
*Populus deltoides* Marsh.  
*Juglans nigra* L.  
*Ulmus americana* L.  
*Ulmus fulva* Mx.  
*Celtis occidentalis* Mx.

*Morus rubra* L.  
*Gleditschia triacanthos* L.  
*Gymnocladus dioica* (L.) Koch.  
*Acer negundo* L.  
*Fraxinus lanceolata* Borak.  
*Quercus macrocarpa* Mx.

The shrubs and lianas are identical with those at the mouth of Mulberry creek. The only peculiar species, therefore, is the Burr oak. The Burr oak, coffee-bean and Black walnut extend up the creek for several miles, about one-third the distance of the wooded part. The other trees and shrubs begin to disappear in about the same order as on Mulberry and North creeks.

In the southwestern part of the country there are more of the characteristic Eastern trees, as the sycamore, Prickly ash, Red juniper, hickory, and a number of oaks. In the northeastern corner the buckeye and bladdernut are present. In passing westward through the northern part of the state the forest belts are of the same character as those on the two small creeks under discussion. At Jennings, in Decatur county, I found about the same creek flora. Only about a mile of Prairie Dog creek was studied; so the woody flora may not be quite complete for the region, but the list shows the striking similarity of the two localities, although there is a decided difference in the herbaceous plants. The following woody plants were observed:

TREES.	SHRUBS.
<i>Salix amygdaloides</i> Anders. <i>Populus deltoides</i> Marsh. <i>Ulmus americana</i> L. <i>Celtis occidentalis</i> L. <i>Gleditschia triacanthos</i> L. <i>Acer negundo</i> L. <i>Fraxinus lanceolata</i> Borak.	<i>Salix fluviatilis</i> Nutt. <i>Ribes aureum</i> Pursh. <i>Rosa arkansana</i> Porter. <i>Prunus americana</i> Marsh. <i>Amorpha fruticosa</i> L. <i>Rhus aromatica</i> Ait. <i>Symphoricarpos occidentalis</i> Hook.
LIANAS.	
<i>Vitis vulpina</i> L.	

The upland of Clay county is not adapted to tree growth naturally. The prairie is a true climatic prairie. Trees like the cottonwood frequently die in about twenty years on the high upland if left to themselves. Box-elders and Black walnut also will not thrive. But in ravines and in creeks and river-bottoms conditions are favorable for abundant tree development if once a stand is secured and the ground is not pastured or burned over by prairie fires. But, because of the prevalence of fires, up to thirty years ago the bottoms were not covered by a forest, except narrow and usually interrupted and comparatively short-lived belts along the banks of the streams. Since the forest belts could not progress outward into the prairie, they were as continually cut away by the meandering of the streams as they were developed. At the present time the timber belts along both the rivers and creeks are progressing outward wherever natural conditions prevail. The writer knows

personally of many forest belts which have traveled outward for a considerable distance in the last twenty years. The same is true of the development of wooded bluffs.

The origin of the different types of forest belts and patches may be considered under the following heads: (1) The river-bottom; (2) the creek bottom; (3) the wooded bluff; (4) the ravine.

*The River-bottom.*—The main development of forest in the river valley is along advancing sand-bars. On the inner side of the river bends the low bar is often overflowed and covered with a rich sediment. On the edge of the bar, above the river-bed proper, there usually grows up a belt of Sand-bar willow (*Salix fluviatilis*) which often travels forward at about the same rate as the bar advances. The roots of this willow spread out beneath the surface of the sand and send out numerous shoots, so that a very close thicket is formed. The Sand-bar willow soon dies, but in the meantime it is replaced by the Peach-leaf willow, and finally by the cottonwood. The cottonwood forest is the normal river-bend forest, and is gradually replaced by the other trees of the river valley which form the culmination flood-plain forest of the region. These trees are as follows: Black walnut, White and Slippery elm, hackberry, Red mulberry, redbud, coffee-bean, Honey-locust, and Green ash. In an old forest which has gone through the normal development, the trees enumerated above make up the bulk of the individuals, with here and there an isolated giant cottonwood, which has escaped destruction.

Sand-hills and ridges blown up by the wind support but a thin stand of grass and other herbs, and in the blowouts and on the newly formed ridges several shrubs, which are forest forerunners, gain a foothold. The most important shrubs are *Prunus watsoni* and *Prunus americana*. Usually the first trees to come in are Honey-locusts, coffee-beans, and, in the deep blowouts, cottonwoods.

Ravines opening into low river-bottoms sometimes lose their channel before reaching the stream, and the soil thus covered with sediment gives rise to a moist-ground forest. The first important trees and shrubs are Sand-bar willow, Peach-leaf willow, and in the lower places *Cephalanthus*. Finally White Elm, Green ash, Black walnut and other trees take possession, and a normal forest is produced.

Cut-off river meanders also frequently give rise to forests. The old channel is gradually filled up with mud and sand, and, where

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water is absent, willows, cottonwoods and other trees soon take possession of the river-bed and its banks.

The river-bottoms are inhabited by great numbers of gophers. These throw up small mounds of earth, sometimes several yards in diameter. Here seeds of trees sprout and a forest results. Formerly the fire prevented much development of this type of forest. But at present gopher hills are a very important factor in the out extension of the forest belts. The Green ash is most aggressive in taking possession of these hills. Rough-leaf dogwood is also important. I know of a number of young forests which have developed in this way since prairie fires have ceased. During the regions of the fires the Green ash could be found far out in the prairie occupying the isolated gopher hills, but burned down so as form a sort of woody crown-former.

*The Creek Bottom.*—Along the smaller creeks there is usually only a narrow belt of forest on both banks, extending from the water up to the flood-plain level. The presence of this forest is due to the moist condition of the creek bank and the layer of alluvium which is deposited at each ordinary rise of the water. The alluvium not only covers the grass and other herbs but gives a very favorable soil for the development of woody seedlings. Where there are sharp bends small, low bars are formed, subject to frequent overflow, and these are covered by a forest of the type in the river valley on a smaller scale. The succession of trees is however not the same. The important tree is the box-elder, which takes the place of the cottonwood along the river. The forest may also extend outward on gopher hills, and the Green ash, so far as it extends up the creek, is the main tree to take possession. The outward extension in the creek bottoms is very marked since prairie fires have ceased. Some low, narrow flood-plains may be entirely wooded, but this is exceptional at present.

The creek-bank forest is continually progressing up stream, and this extension is now very rapid because of the large amount of sediment brought down from plowed ground. On Mulberry creek, near the upper limit of the timber belt, the alluvium was very abundant and covered with a luxuriant growth of large weeds. The beginnings of a forest were shown by the presence of large numbers of young trees of box-elders, cottonwood, and Peach-leaf willow.

*The Wooded Bluff.*—The steep bluffs along the river, creeks and larger ravines furnish another physiographic form favorable for forest development. The bluffs most completely wooded face the

north. The south-facing bluffs are usually too dry for forest growth. After the slope is of sufficient steepness much wash accumulates toward the base and affords protection for young trees from fire and a good soil for seedlings to develop. Because of shade, slowness of evaporation, and safety from fire, the steep north-sloping bluff often supports a small growth of trees even where the creek bank is barely beginning to harbor isolated thickets and the first young pioneers among the trees. The trees of the wooded bluffs are mostly hackberry, White elm, wild plum, Rough-leaf dogwood, Smooth sumac, and Choke-cherry, with a number of smaller shrubs and lianas.

*The Ravine.*—The ravine valleys are usually so narrow that fires were very destructive, and formerly they contained little besides small thickets of *Amorpha fruticosa*, usually confined to the banks of ponds, Sand-bar willow, elderberry, Smooth sumac, and Poison ivy, which usually grew as a sort of crown-former with annual aerial shoots. But at present Peach-leaf willows, cottonwoods, and occasionally White elms, Green ashes, box-elders, and escaped Osage oranges and White mulberries are developing very rapidly, so that where fire and grazing are absent little forest belts are appearing where thirty years ago there was nothing but pure prairie. The abundant sediment deposited from the cultivated fields is probably a very important factor at present in facilitating tree development in the ravines. The steep north-facing bluffs of the larger ravines are often covered with thickets of wild plum, Rough-leaf dogwood, Smooth sumac, gooseberry, coral-berry, and raspberry. Very often, also, Poison ivy and Riverside grape are present, and occasionally a tree.